

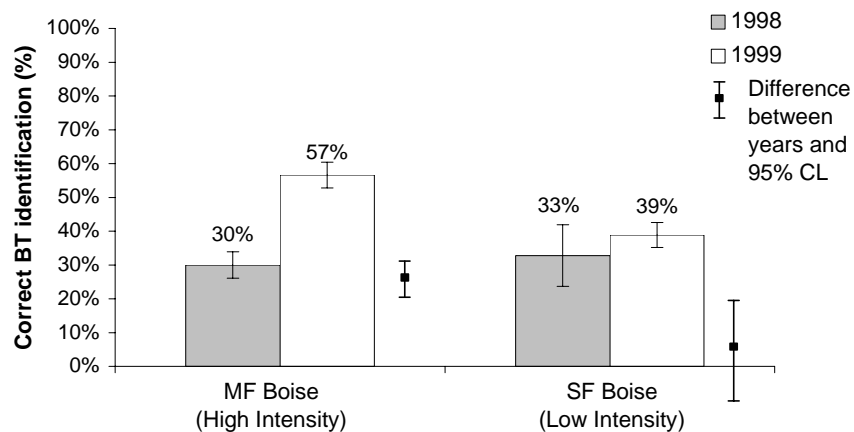


ANGLER BEHAVIOR STUDIES

The Effect of Three Education Strategies on Angler Ability to Identify Bull Trout and Other Salmonids

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Project 5. Angler Behavior Studies:

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ABSTRACT

We evaluated the effect of three bull trout education strategies implemented at two intensity levels on angler regulation awareness and ability to identify salmonids on the Middle Fork Boise River (MFBR) and South Fork Boise River (SFBR). This was accomplished by conducting field interviews of anglers in the year before and immediately after implementation of the education program. Overall, MFBR anglers exposed to a high intensity education effort were only slightly better at correctly reciting section-specific regulations post-education compared to the previous year, while recitation ability for anglers on the low intensity stream (SFBR) actually declined. Education efforts tested at both intensities had a positive effect on angler ability to recite the bull trout no-harvest regulation, increasing from 65% to 91% on the MFBR and 58% to 77% on the SFBR. Angler ability to identify bull trout nearly doubled from 30% to 57% under the high intensity program but did not improve statistically under the low intensity program. Education intensity appeared to affect the pre-post identification results for species other than bull trout in the two study streams. Our evaluation indicates that, of the three education tools tested, road signs were by far the most effective method for improving angler knowledge of bull trout regulations and bull trout identification. Angler response to two poster styles was disappointingly low, and we recommend the use of larger road signs over streamside poster programs if such measures are being contemplated. Results from the study suggest that a business card campaign involving distribution to license vendors provided little benefit, although, due to production delays, our evaluation was incomplete. Despite the presence of a large number of anglers who remained unable to identify bull trout post-education, harvest of bull trout due to misidentification declined from 0.006-0.007 fish/h in 1998 to 0.0 on both streams in 1999 following program implementation. It is possible that anglers acted on the campaign slogan "If you don't know, be safe, and let it go" when they were unsure how to identify fish in their creels.

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INTRODUCTION

In January 1994, the Idaho Fish and Game Commission adopted a statewide no-harvest regulation for bull trout *Salvelinus confluentus* in all but one Idaho water, Lake Pend Oreille, where limited harvest was allowed. In 1996, the Commission closed that fishery to bull trout harvest as well. These actions were intended to enhance bull trout populations and assist with rebuilding of depressed stocks where necessary. Subsequently, the U.S. Fish and Wildlife Service formally listed bull trout as a threatened species in June 1998.

An implicit assumption of the no-harvest restriction or any regulation requiring the release of most or all fish is that anglers can correctly identify various species. Several investigators have assessed the ability of anglers to identify sportfish with mixed results. Green et al. (1983) reported that 93 of 95 of Texas saltwater anglers (98%) could correctly identify the saltwater fish in their creel but were unclear if all the identifications were to species level. In Alberta, 77% to 83% of anglers in the Highwood River and Sheep River drainages were able to correctly identify bull trout from pictures (Isley 1997). A lower proportion of Montana anglers (44%) were able to correctly identify bull trout from a variety of replicas, including photographs, drawings, mounts, live fish in aquariums, or fish in the creel (Schmetterling and Long 1999). Schill and Lamansky (1999) estimated that only 30% to 45% of southwest Idaho anglers could identify bull trout replicas in two drainages. Results for four other species including brook trout *Salvelinus fontinalis*, brown trout *Salmo trutta*, cutthroat trout *Oncorhynchus clarki* and rainbow trout *Oncorhynchus mykiss* ranged from 30% to 80%, respectively. Schwartz (2000) provided no numerical evidence but asserted that anglers commonly misidentify various salt and freshwater fish species in southeastern America. Thus while a single author above reported excellent fish identification ability by anglers, subsequent authors have reported moderate to poor angler ability to identify gamefish species.

Schill and Lamansky (1999; In Review) also summarized results from a number of studies that reported varying levels of regulation awareness in recreational fisheries. Regulation awareness as measured by angler ability to correctly recall pertinent regulations has ranged from 14% or less for Lubbock, Texas anglers in an urban setting (Schramm and Dennis 1993) to 96% on a catch-and-release stream segment where no harvest was permitted (Schill and Kline 1995). Poarch and Lyons (1994) reported that 98% to 99% of crappie anglers knew the correct regulation but did not state if anglers were asked to actually recite the regulation. If anglers are unaware that species-specific regulations exist for a given water, they are also oblivious of the need to correctly identify individual species (Schill and Lamansky In Review).

Although often called for (e.g., Paragamian 1984; Brousseau et al 1987; Schramm and Dennis 1993; Schmetterling and Long 1999), few concerted efforts to educate the public have been documented in the fisheries literature, and even fewer studies have quantitatively evaluated success. Following an extensive information and education campaign, Baayens and Brewin (1998) reported that 90% of 903 survey respondents were aware of the statewide no-harvest regulation for bull trout in Alberta. However, they presented no pre-education campaign data for comparison and did not evaluate angler response to the individual education methods employed. Martin (1995) used a multifaceted education campaign that encouraged anglers to harvest largemouth bass *Micropterus salmoides* outside a protected slot. Although the level of angler exposure to the education campaign was not assessed, the overall success of the program was; anglers did not cooperate with the regulations. Dolsen and Landry (1996) conducted a detailed pre-post survey evaluation of a public information campaign designed to educate the public about a number of western Montana fisheries issues. The authors reported

a statistically significant positive change in 20 of 75 survey questions with only two changing in a negative direction. Despite the few studies noted above, little formal evaluation of education programs in fisheries management has apparently been conducted.

In contrast, considerable energy has been devoted to evaluation of education tools in other recreational or other professional fields. Past studies have evaluated the effects of signs and brochures on littering (Marler 1971; Durdan et al. 1985; Reiter and Samuel 1980; Oliver et al. 1985), speeding (Galizio et al. 1979), compliance with handicap parking space reservations (Jason and Jung 1984), and a variety of campground rules (Ross and Moeller 1974). In general, these past researchers have demonstrated that sign placement and message tone can influence education program success.

Based on results from their Montana study on angler ability to identify trout, Schmetterling and Long (1999) stated that successful native species management would require educational intervention. Our study was initiated to determine if education programs could be developed to measurably improve southwest Idaho angler regulation awareness and ability to identify salmonids. Although interest exists for increasing angler identification ability for all Idaho fish species, the effort documented below focuses on bull trout, the primary target species, due to their threatened ESA status.

Our original study design involved a treatment/control approach with education efforts being conducted on the Middle Fork Boise River (MFBR) and with the South Fork Boise River (SFBR) serving as the control. However, results of the 1998 surveys (Schill and Lamansky 1999) indicated that bull trout identification by anglers was poor enough that Idaho Department of Fish & Game (IDFG) Regional Management staff administering the SFBR were unwilling to wait an additional year before undertaking an education effort. Consequently, before the 1999 angling season, educational efforts were undertaken for both the MFBR and SFBR. Because of this action, we were unable to pursue the treatment/control approach and designed our study to compare the effects of a high intensity education effort versus a lower intensity approach used in a typical IDFG management education effort. The intensity of education efforts in the two study waters was varied substantially and results of the two approaches compared.

OBJECTIVES

1. Develop education strategies designed to improve Idaho angler ability to identify bull trout.
2. Evaluate the effects of three experimental education tools on angler regulation awareness and their ability to identify bull trout and other southwest Idaho salmonids.

STUDY AREA

During the 1999 field season, angler interviews were conducted on nine discrete sections of the upper Boise River drainage (Figure 1). These sections were characterized by different water types (reservoir or stream) and overall management approaches (stocked/yield or special regulations). We followed the same section numbering scheme employed during the 1998 field season (Schill and Lamansky 1999), although no interviews were conducted in Section 6 during 1999. Rohrer (1989) provides a detailed physical description of the study area.

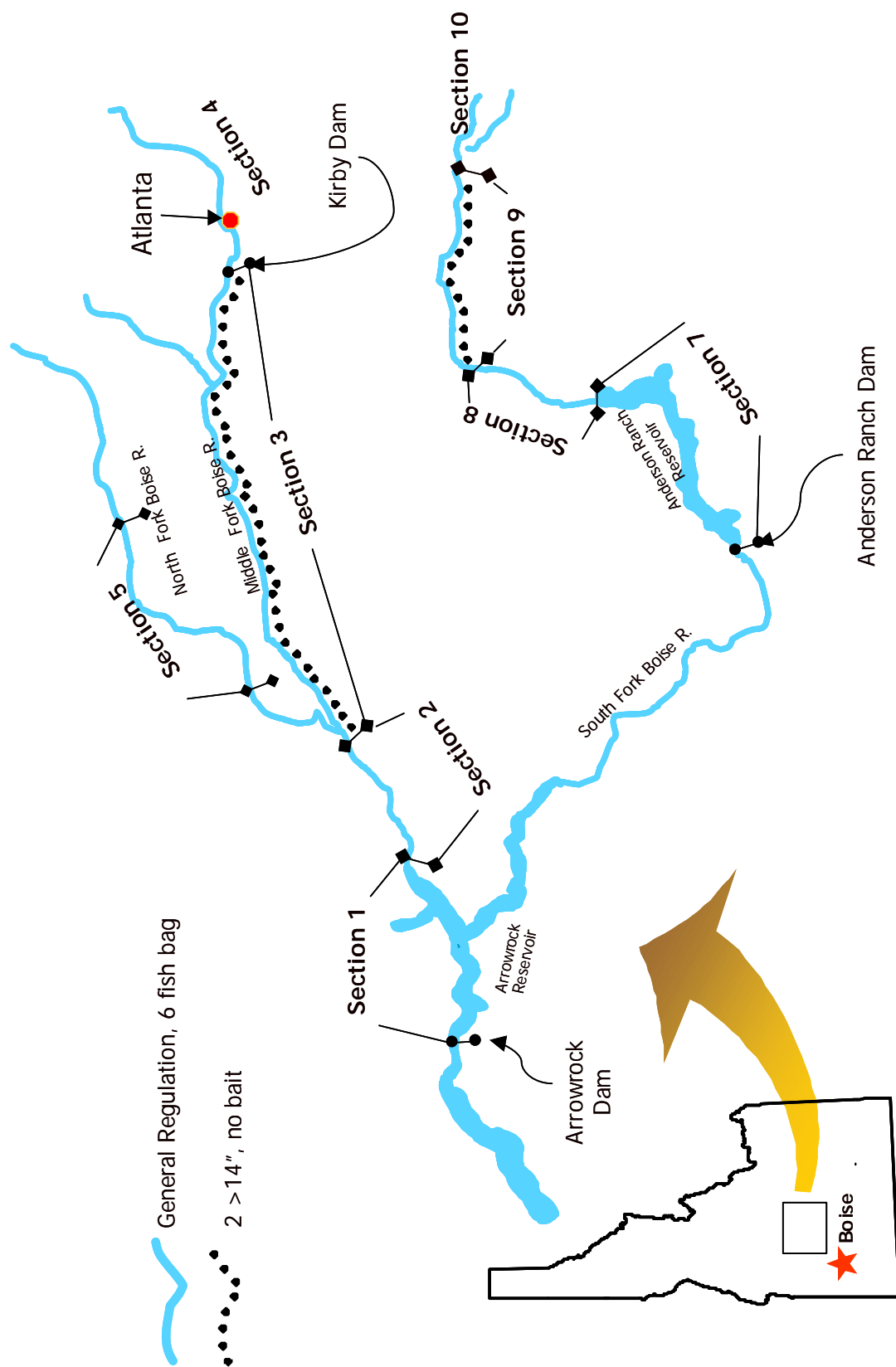


Figure 1. The Middle Fork Boise River and South Fork Boise River drainages and study sections used in the 1999 fish identification survey.

Sections 1-5, Middle Fork Boise River

The entire pool of 24.9 km long (1275 ha) Arrowrock Reservoir comprised Section 1. Section 2 began at the beginning of flowing water for the MFBR immediately below Willow Creek campground and extended 16.9 km upstream to the North Fork Boise River (NFBR) confluence. Section 3 on the MFBR began at the NFBR confluence and ended at Atlanta Dam (56.3 km). Section 4 began at Kirby Dam and included only the next 1 km area of slack water immediately upstream. Section 5 included the roaded portion of the NFBR from the Rabbit Creek confluence to Deer Park Bridge, a distance of 25.1 km.

Sections 7-10, South Fork Boise River

The entire pool of 21 km (1918 ha) Anderson Ranch Dam comprised Section 7. Section 8 began at the start of flowing water for the SFBR at Pine and extended upstream 35.2 km to the confluence of Beaver Creek and the SFBR. Section 9 on the SFBR began at the Beaver Creek confluence and ended at the confluence of the SFBR and Big Smokey Creek (15.8 km). Section 10 included that portion of Big Smokey Creek upstream of the SFBR confluence to the Canyon Campground at the end of the road (4.9 km) and the roaded portion of Little Smokey Creek (8.8 km).

Angling Regulations (All Sections)

Anglers fishing in Sections 1, 2, and 5 of the MFBR were restricted only by the general regulation bag limit of six trout with no size or gear restrictions. On the SFBR, Sections 7, 8, and 10 were all managed under the same general regulation (Table 1). Section 3 anglers on the MFBR and Section 9 anglers on the SFBR were restricted to harvest of two trout over 355 mm. In addition, both bait and barbed hook use was prohibited on these two sections. Given the size of trout in the two streams, this special regulation results in the vast majority of all trout caught being released. As noted above, statewide angling regulations for bull trout in all sections completely restrict harvest.

Table 1. Angling regulations for individual sections in the study area, Middle Fork Boise River and South Fork Boise River, 1999^a.

Regulation	MFBR Section	SFBR Section
General trout limit (no size or gear restrictions)	1, 2, 4, 5	7, 8, 10
Two trout over 355 mm, (artificial fly or lure only, no bait and barbless hooks)	3	9

^a No bull trout harvest allowed statewide.

METHODS

Education Program Development

High Intensity Education-MFBR

Before the 1999 angling season opener, we installed 25 1.6 m X 1.6 m metal road signs in the drainage. Sign design and verbiage was developed via interagency consensus with IDFG, U.S. Bureau of Reclamation (BOR), and U.S. Forest Service (USFS) staff. The signs contained white lettering and brown background colors typical of federal resource management signing programs. They were placed along all access routes into the MFBR, at access ramps, on short spur roads to Arrowrock Reservoir, and at several bridge crossings (Figure 2). Sign locations were jointly agreed upon with BOR and USFS staff before installation. By design, signs were located so that all anglers would have to drive by at least two to reach any fishing site. The signs all began with a large header stating "Anglers, You Are In (or Entering) Bull Trout Country" (Brewin 1997). Signs encountered initially on all access routes into the drainage noted anglers were *entering* bull trout country, while signs subsequently encountered reminded anglers they were *in* bull trout country. In addition to the headers, signs featured a 725 mm long color picture depicting a bull trout, noted several key identifying characteristics, reminded anglers that bull trout possession could result in a \$200 fine, and ended with the slogan "If you don't know, be safe, and let it go!" (Appendix 1).

A second educational tool evaluated was two versions of a poster containing similar information as the signs above except that the headings were designed to attract angler curiosity. One poster was titled "Know Your Bull!"; the second was titled "WANTED; Anglers who can identify Bull Trout" (Appendix 2). In the high intensity treatment, 0.30 X 0.67 m posters were attached to 0.50 X 0.67 m birdbacks mounted on t-posts and displayed free-standing, away from other informational signs whenever possible. Posters were attached to birdbacks on the MFBR at 40 of 47 sites; in remaining locations they were attached to larger USFS bulletin boards. Posters were concentrated in campgrounds, unimproved campsites, boat ramps, and other high use areas at sites agreed upon by project personnel and the USFS recreation staff. Posters were installed before the 1999 angling season and were maintained each day that interviews were conducted. Project personnel recorded the number of times individual posters needed to be replaced during the entire angling season.

A final educational option tested was 5 X 10 cm business cards that contained similar basic information as the signs and posters (Appendix 3). These cards were distributed to IDFG Regional enforcement personnel and were mailed to all local license vendors in southwest Idaho for distribution to anglers. The cards were constructed of sticky-backed bumper sticker material and henceforth referred to as "stickers." Anglers were encouraged to attach stickers to their boats, tackle boxes, fly boxes, etc. to aid in future bull trout identification efforts. Due to production delays, stickers were not mailed to license vendors until May 27.



Figure 2. Location of road signs posted along the Middle Fork Boise River (High Intensity education) and South Fork Boise River (Low Intensity education), May to October, 1999.

Low Intensity Education

The low intensity education program also relied upon 1.6 X 1.6 m metal road signs but were designed and constructed solely by the IDFG Magic Valley Regional Management staff. These signs contained the header "ATTENTION ANGLERS, KNOW YOUR FISH," black lettering on a white background, verbiage highlighted in red reminding anglers that bull trout possession could result in a \$200 fine, and a large color image of a bull trout (Appendix 4). Four signs were placed in the SFBR, three on entrance roads, and one near the uppermost bridge crossing (Figure 2).

The posters discussed above for use in the MFBR high intensity treatment were also distributed statewide for use by IDFG Fishery Management staff. Ten "Know Your Bull" and "Wanted" posters were distributed throughout the SFBR drainage. Poster location was determined solely by USFS personnel, and birdbacks were not used. Posters were typically displayed on larger bulletin boards along with other information and were not maintained during the season as on the MFBR. Southwest Idaho anglers fishing the SFBR also had the same chance as MFBR anglers of encountering stickers when visiting license vendors or being contacted by IDFG personnel while angling. Overall, of total posters and signs used in the two study drainages, the intensity of the SFBR program was roughly one fifth to one sixth that implemented on the MFBR (Table 2).

Table 2. Comparison of education efforts on the Middle Fork Boise River and South Fork Boise River, 1999^a.

	High Intensity (MFBR)	Low Intensity (SFBR)
Signs	24 (0.31/km)	4 (0.06/km)
Posters	47 (0.62/km) birdbacks weekly maintenance	10 (0.16/km) no birdbacks no maintenance
Stickers	To Boise area vendors May 27 90,000 mailed statewide July 25	

^a Linear intensity estimates (number/km) based on stream km and not road km

Angler Interviews

We used the same general interview approach as that in the pre-education survey conducted during the 1998 field season (Schill and Lamansky 1999). Interviews were conducted on the MFBR and SFBR from the general fishing season opener on May 29 through October 1, 1999. During 1999, angler contacts on both waters were made on randomly selected days during the entire study period. On the MFBR, two weekdays and one weekend

day per week comprised interview days while a single weekday and weekend day comprised the interview schedule for the SFBR.

Project personnel drove the length of the study area each sampling day and approached individual anglers when encountered in the various study sections. We interviewed those anglers observed fishing and interviewed individuals in campgrounds adjacent to the various study sections when they indicated they normally fished the stream or reservoir in the vicinity. Anglers interviewed while fishing were first asked a series of standard creel survey questions including residency, hours fished, gear type, and number/species of salmonids kept and released. Anglers interviewed but not observed fishing that day were asked only the residency and gear type questions.

The second portion of the interview pertained largely to fish identification. All anglers were first asked their age and if they would recite the fishing regulations for the area that they were fishing. Next, we asked them to rate their ability to identify various kinds of trout on a scale of 1 to 5, with 5 being most confident (Appendix 5). For anglers with fish in the creel, we observed their catch, recorded the species, and then asked anglers if they could identify the fish they had kept. Their species observations were recorded next to those of the project clerk. Next, we asked anglers to identify five different 250-280 mm trout replicas (cast mounts) depicting a brook trout, bull trout, rainbow trout, cutthroat trout, and brown trout. Although all of these species are present in the Boise River drainage, brown trout were not present in the actual study area and cutthroat trout are rare. All five replicas were attached to a 1 x 1 m board with a handle on top for easy transport. Each of the five replicas was covered individually with fabric and anglers were only permitted to view and identify one at a time. To eliminate potential bias from guessing, we systematically varied the order of presentation to anglers so each fish had the same probability of being viewed first. To conclude the identification portion of the interview, we asked anglers if they had been interviewed for fish identification before via the same process, either in 1998 or 1999.

Following the identification exercise, anglers were asked several additional questions pertaining largely to bull trout. We first asked them if they could recite the regulation for bull trout. For correct respondents, we then asked what their primary source of information on the no-harvest regulation was, and subsequently inquired about any secondary sources. Although these two questions were open-ended, we placed their responses into one of 12 possible source categories including signs, posters, stickers, the IDFG regulation booklet, television, fish and game staff, radio, newspaper, license vendor, magazines, word of mouth, or personal experience. The intent of this question was to quantify the usefulness of the three education tools being tested relative to each other and other media or information sources. Next, anglers who correctly identified the bull trout replicas were asked how they obtained primary and secondary information on bull trout identification. The same options as above were used to categorize their responses. The interview was concluded by asking the angler how many years of education they had completed.

Data Analysis

We summarized angler responses to regulation knowledge and fish identification questions by study section and gear type used for both study waters. Results were compared for pre-and post-education years when sample size permitted. Although these data lend themselves to chi-square analysis, we did not analyze them in this manner because a number of recent authors have questioned the utility of null hypothesis testing (Hilborn 1997; Johnson

1999; Anderson et al. 2000). Johnson (1999) noted that an ordinary confidence interval provides more information than a P-value derived via a statistical test, because it provides a measure of both effect size and a measure of its uncertainty. Anscombe (1956) suggested that hypothesis tests are completely irrelevant, and that the information actually needed was estimates of magnitudes of effects with standard errors. Accordingly, for both bull trout identification and regulation awareness rates, we constructed confidence bounds around the difference in the proportion of correct responses during the two study years using the following formula from Fleiss (1981):

$$\text{UpperBound} = (p_2 - p_1) + 1.96 \sqrt{\frac{p_1 q_1}{n_1} + \frac{p_2 q_2}{n_2}} + \frac{1}{2} \left(\frac{1}{n_1} + \frac{1}{n_2} \right)$$

$$\text{LowerBound} = (p_2 - p_1) - 1.96 \sqrt{\frac{p_1 q_1}{n_1} + \frac{p_2 q_2}{n_2}} - \frac{1}{2} \left(\frac{1}{n_1} + \frac{1}{n_2} \right)$$

where p_1 = the proportion of correct responses during 1998 (pre-education)
 p_2 = the proportion of correct responses during 1999 (post-education)
 q_1 and q_2 = the complement of p_1 and p_2 and
 n_1 and n_2 = the sample size during the two study years

For the MFBR, we also calculated the proportion of demographic groups (sex, age, residence, years of angling experience, years of education) that could accurately recite the appropriate angling regulation and that could correctly identify the various trout replicas in the pre- and post-education periods. Other than gear type, we did not attempt to summarize questionnaire responses by demographic groups for the SFBR due to limited sample sizes in the 1998 sample.

We constructed 95% confidence limits around proportions using the standard binomial approximation (Zar 1974):

$$p \pm 1.96 \sqrt{\frac{pq}{n}}$$

p = the proportion in question
 q = the complement proportion of p
 n = sample size

A complex but more accurate formula was used for proportions less than 0.10 or greater than 0.90 as suggested by Fleiss (1981).

RESULTS

Regulation Awareness

During 1999, 24% to 60% of anglers interviewed on general regulation sections (Sections 1, 2, 4, 5, 7, 8, and 10) successfully recited the six fish bag limit. Regulation awareness was greatest (69% to 70%) for anglers fishing the two special regulation sections (Sections 3 and 9) despite more complex restrictions. These results do not include correct responses to the bull trout no-harvest regulation for those sections.

Overall, MFBR anglers were only slightly better at correctly reciting section-specific regulations (51%) in 1999 compared to 1998 (47%). On the SFBR in 1999, 40% of anglers correctly recited section-specific regulations, a decline from 1998 (54%). A comparison of results by section reveals that angler ability to recite section-specific regulations declined in five of six sections where more than 10 interviews were available for both study years (Table 3).

As in the previous year, 1999 anglers were more likely to recite the no-harvest restriction for bull trout correctly than section-specific fishing regulations. For all sections, a total of 91% of MFBR and 77% of SFBR anglers correctly recited the no-harvest regulation for bull trout during 1999 (Table 3). Correct bull trout regulation recitation ranged from 84% in Section 1 (Arrowrock Reservoir) to 100% on Section 4, although the latter rate was based on only five interviews. Both of these sections were managed under general regulations. Within each of the two study streams, bull trout regulation awareness was lowest on the reservoirs at 85% and 71% in Sections 1 and 7, respectively.

Education efforts in both the MFBR and SFBR had a positive effect on bull trout regulation awareness based on a comparison of 1998 and 1999 survey results. Angler ability to recite the no-harvest regulation increased post education for all six sections where sample sizes in both years exceeded 10 interviews (Table 3).

Overall, MFBR angler ability to correctly recite the bull trout regulation improved from 65% in 1998 to 91% in 1999, a difference of 26% (Figure 3). Confidence bounds around this pre- and post-education difference range from 21% to 31%. On the SFBR, angler ability to recite the regulation improved from 58% in 1998 to 77% in 1999. However, the confidence limit around this 19% difference was much less precise, ranging from 6% to 32% (Figure 3).

Ability to Identify Trout

Prior to the realization that they were going to be asked to actually identify trout replicas, anglers on both study waters rated themselves slightly above average in their ability to identify trout. On a scale of 1 to 5, with 5 being an expert, the average self-reported ability to identify different trout species was 3.3 for MFBR anglers and 3.2 for SFBR anglers during 1999; values identical to 1998 results. For both streams combined, self-reported fish identification ability shifted slightly among the three different gear types between 1998 and 1999. Self-reported ability of fly anglers declined from 3.6 in 1998 (n = 231) to 3.2 in 1999 (n = 366) along with lure anglers from 3.3 (n = 99) to 2.5 (n = 335). However, bait angler assessment of their own ability to identify trout increased from 3.1 in 1998 (n = 282) to 3.6 in 1999 (n = 513).

Our comparison of biologist versus angler identifications of trout creel by anglers was hampered by limited sample size. Forty-nine of 52 (94.2%, 95%CL = 83-99) anglers in both

streams had one or more rainbow trout in the creel and correctly identified them. Sample sizes for other species observed in the creel were too small to calculate useful proportions. Of note, however, the correct identification rate for 17 anglers with creeled kokanee, all caught in Anderson Ranch Reservoir, was 88%.

Implementation of the high intensity education program on the MFBR appeared to increase identification rates for the target species, bull trout. Bull trout were the least correctly identified fish in 1998 but were the second most commonly identified species in 1999 following the education effort. On the MFBR, the greatest gains in correct bull trout identification rates occurred in Section 1 (Arrowrock Reservoir) and Section 5 (North Fork Boise River) where a 2.4- and 2.7-fold increase occurred, respectively (Table 3). Overall, correct angler identification rates for bull trout on the MFBR nearly doubled from 30% in 1998 to 57% in 1999. Confidence limits around point estimates for the two years did not overlap (Figure 3).

On the SFBR, angler ability to identify bull trout did not appear to markedly improve following the low intensity education effort. Correct bull trout identification rates appeared to improve on Section 7 and decline in Section 8, although the small sample size in 1998 could account for the decline in the latter (Table 3). Overall, correct angler identification rates for bull trout on the SFBR increased only slightly from 33% in 1998 to 39% in 1999 and confidence limits around point estimates for the two years overlapped (Figure 3).

We observed differing changes in angler ability to identify other salmonids on the two waters following implementation of the high and low intensity education programs targeted only at bull trout. On the MFBR, rainbow trout identification rates increased from 81% in 1998 to 90% in 1999 (Figure 4). Identification rates for brook trout and cutthroat trout on the MFBR also increased; only brown trout identification rates appeared to decline (Figure 4). In contrast, on the SFBR, angler ability to identify non-targeted salmonids either declined or, in the case of rainbow trout, remained the same (Figure 4).

Table 3. Summary of regulation awareness and angler ability to correctly identify bull trout replicas for anglers in various sections of the Middle Fork Boise River and South Fork Boise River, 1998 and 1999^a.

Year	Middle Fork Boise						South Fork Boise				
	All	Sec 1	Sec 2	Sec 3	Sec 4	Sec 5	All	Sec 7	Sec 8	Sec 9	Sec 10
Correctly recited section-specific regulation											
1998											
Percent	47	38	38	74	54	33	54	53	69	25	0
95% CL	(42-51)	(29-47)	(30-46)	(66-81)	(35-72)	(24-41)	(42-66)	(39-67)	(44-94)	a	a
n	550	114	153	136	28	119	67	49	13	4	1
1999											
Percent	51	32	35	70	20	60	40	24	39	69	44
95% CL	(46-54)	(24-40)	(27-42)	(63-76)	a	(51-70)	(36-44)	(19-30)	(32-46)	(59-78)	(36-52)
n	639	152	153	214	5	115	624	219	200	93	112
Correctly recited statewide bull trout regulation											
1998											
Percent	65	50	66	78	82	57	58	55	62	75	100
95% CL	(60-69)	(41-59)	(58-74)	(70-84)	(62-93)	(48-66)	(46-70)	(41-69)	(36-89)	a	a
n	550	114	153	136	28	119	67	49	13	4	1
1999											
Percent	91	84	88	93	100	99	77	71	78	88	80
95% CL	(88-93)	(76-89)	(82-93)	(88-96)	a	(95-100)	(74-81)	(64-76)	(71-83)	(79-94)	(70-86)
n	639	152	153	214	5	115	624	219	200	93	112
Correctly identified bull trout replica											
1998											
Percent	30	18	29	42	39	26	33	27	54	50	0
95% CL	(26-34)	(12-27)	(22-37)	(33-50)	(21-58)	(18-34)	(21-44)	(14-39)	(26-82)	a	a
n	550	114	153	136	28	119	67	49	13	4	1
1999											
Percent	57	43	58	58	40	70	39	30	42	54	37
95% CL	(53-60)	(35-51)	(50-66)	(52-65)	a	(62-79)	(35-43)	(24-36)	(36-48)	(43-64)	(27-45)
n	639	152	153	214	5	115	624	219	200	93	112

^a = confidence limits not calculated if sample size less than 10

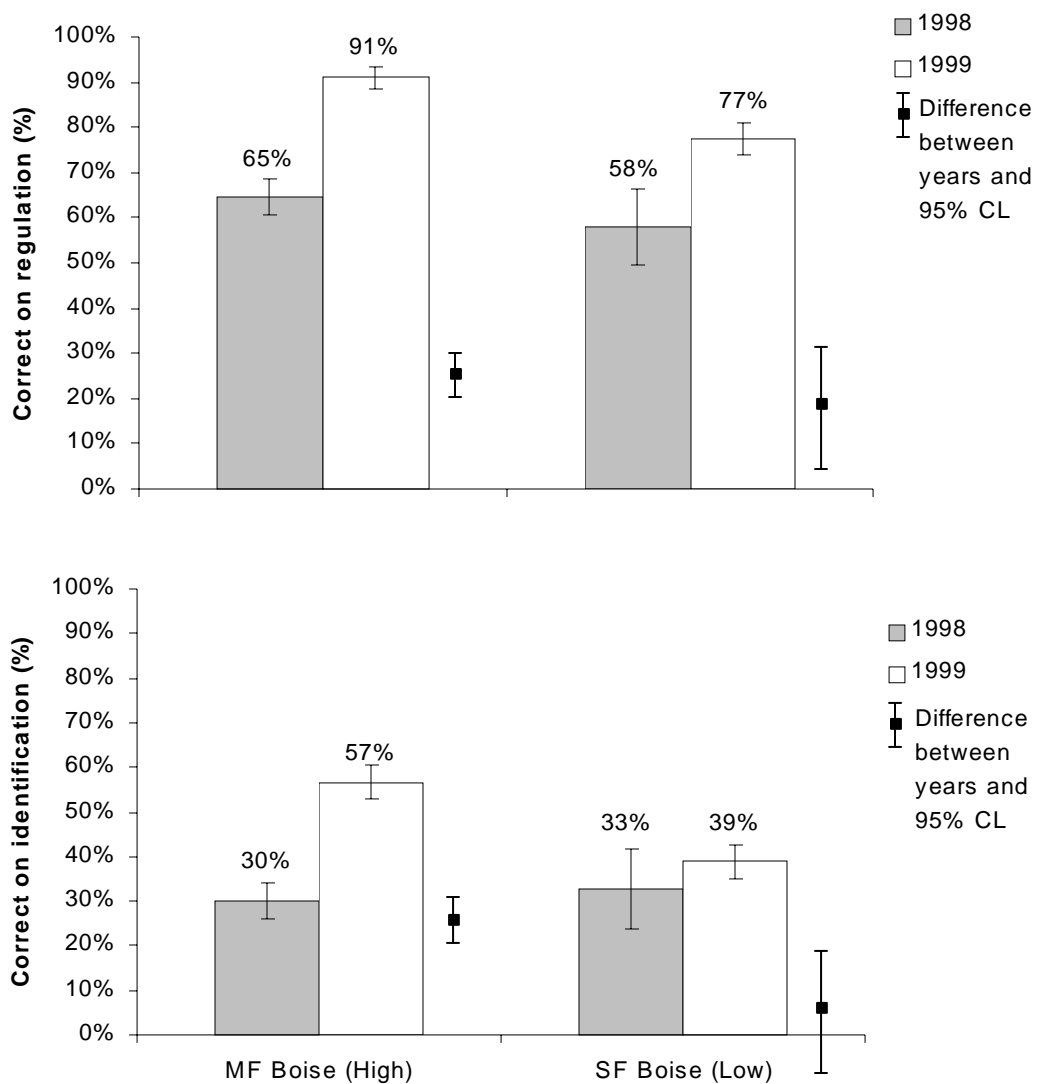


Figure 3. The percent of Middle Fork Boise River and South Fork Boise River anglers that correctly recited the bull trout regulation (top) and identified the bull trout replica (bottom) before (1998) and after (1999) education efforts at two intensities. Black point estimates represent differences between years; associated bars are 95% confidence limits around this difference.

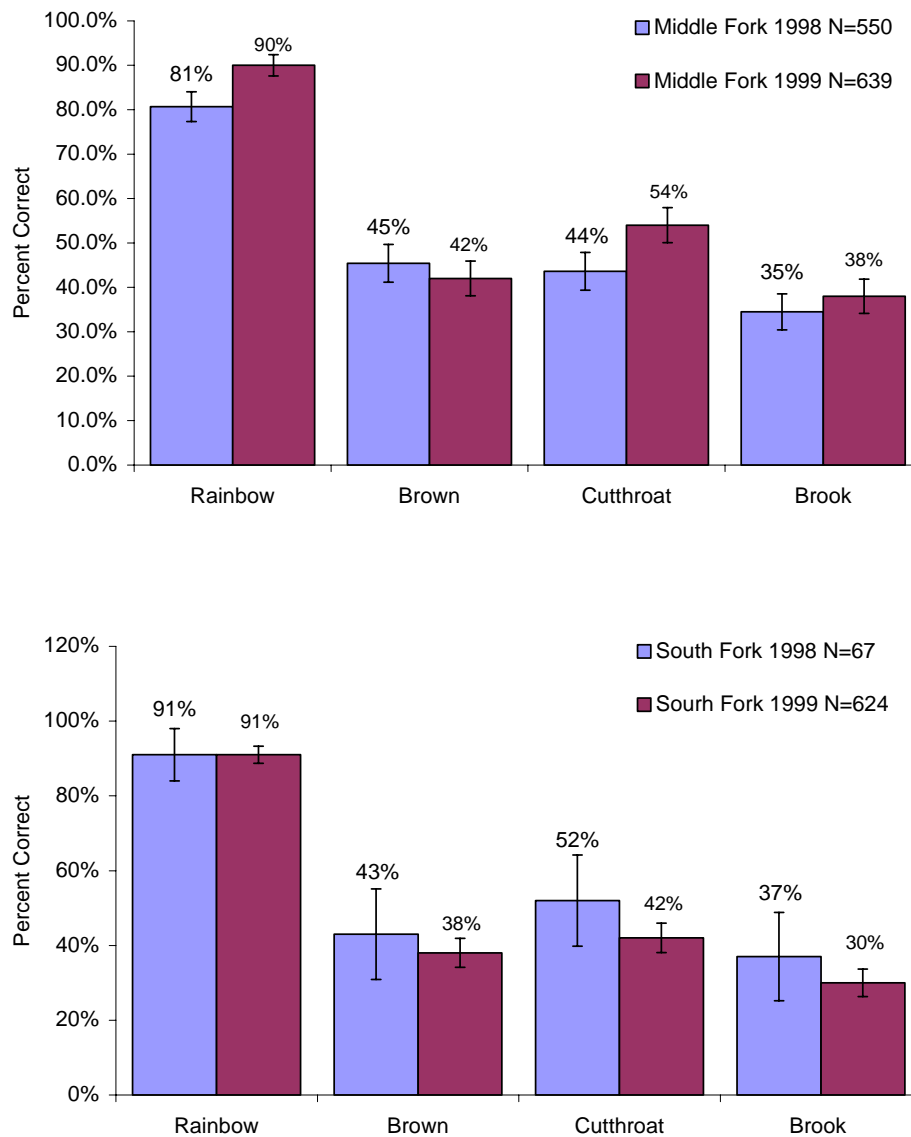


Figure 4. Percentage of total anglers interviewed on the Middle Fork Boise River and South Fork Boise River who correctly identified trout species that were not targeted in the 1999 education campaign for bull trout.

Repeat Interviews

On the MFBR, 43 anglers (7%) interviewed in 1999 were also interviewed in the pre-education year (1998). As expected, those anglers being interviewed a second time were correct in answering the various questions a much higher proportion of the time than those anglers not interviewed previously. In 1999, MFBR anglers who had also been interviewed in 1998 could successfully recite the site-specific regulation 79% of the time compared to 48% of those who had not been interviewed in 1998. Similarly, 98% of anglers interviewed in 1998 could recite the bull trout regulation correctly in 1999 compared to 90% of anglers interviewed the first time. Finally, 79% of anglers interviewed in 1998 could correctly identify the bull trout in 1999 compared to 55% of those interviewed for the first time.

Inclusion of 1999 interview data for those MFBR anglers also interviewed in 1998 made little difference in study results or conclusions. For example, including interviews of those anglers surveyed twice resulted in a 1% to 2% increase in the estimated proportion of 1999 anglers able to correctly recite either the bull trout or section-specific regulation, or to correctly identify the bull trout replica. Because these differences were insignificant from a management perspective, we included all angler responses in the 1999 results, even if they had been surveyed in 1998.

Information Sources

Depending on study stream, the three education approaches tested produced differing results in terms of angler ability to recite the bull trout no-harvest regulation. On the MFBR, the numerous large signs were the primary source of information (57%) for those anglers able to correctly recite the regulation (Table 4). The IDFG regulation pamphlet was used by 20% of correct anglers, followed by anglers relying on word of mouth (6%). Five percent of anglers who knew the bull trout regulation indicated that the posters were their primary information source and only 1% used the stickers as a primary source. Anglers who listed the signs, posters, or stickers as secondary information sources in regard to the bull trout regulation comprised 16%, 3% and 1% of MFBR anglers, respectively.

On the SFBR, the road signs were the primary source of information for 40% of correct anglers, followed by the IDFG regulation pamphlet (31%) and word-of-mouth (13%). The posters and stickers accounted for 3% and 1% of the correct regulation responses, respectively. On both study waters, personal experience and television information played little role in regulation awareness (Table 4). Anglers who listed the signs, posters, or stickers as secondary information sources in regard to bull trout identification ability comprised 12%, 2% and 1% of SFBR anglers, respectively.

In contrast to the above results for regulation awareness, personal experience was the most frequently cited primary information source for anglers correctly identifying bull trout on both study waters. On the sparsely signed SFBR, experience accounted for 41% of responses, while the signs accounted for only 16% (Table 4). On the MFBR, experience accounted for 32%, while the relatively numerous signs accounted for 28% of correct identification responses. The IDFG regulation pamphlet accounted for 18% to 19% of correct responses on both waters. The posters and stickers played a minor role in correct bull trout identification accounting for 5% to 6% and 1% to 2% of correct responses on both streams. Television and word-of-mouth again played little role in correct bull trout identification (Table 4). The signs, posters and stickers comprised a secondary information source for 7%, 1%, and 0% of MFBR anglers and 3%, 1%, and 0% for SFBR anglers, respectively.

Table 4. Primary information source for anglers able to correctly recite bull trout no-harvest regulations or identify bull trout replica based on field interviews, Middle Fork Boise River and South Fork Boise River, May to September 1999. Information sources are represented by: S (signs), R (regulations), P (posters), WM (word of mouth), TV (television), ST (stickers), EX (experience) and O (other^a).

<u>Water</u>		<u>Total</u>	<u>Information source</u>							
			<u>S</u>	<u>R</u>	<u>P</u>	<u>WM</u>	<u>TV</u>	<u>ST</u>	<u>EX</u>	<u>O</u>
Correctly recited state-wide bull trout regulation										
MFBR	Percent		57	20	5	6	3	1	4	5
	95% CL		(52-61)	(17-24)	(3-5)	(4-8)	(2-4)	(<0-2)	(2-6)	(4-7)
	n	580	328	117	29	34	15	5	22	30
SFBR	Percent		40	31	3	13	4	1	3	5
	95% CL		(36-45)	(27-35)	(1-4)	(10-16)	(2-6)	(<0-3)	(2-6)	(3-8)
	n	477	192	147	12	62	18	5	16	25
Correctly identified bull trout replica										
MFBR	Percent		28	19	6	3	1	1	32	11
	95% CL		(23-33)	(14-23)	(4-9)	(2-6)	(<0-2)	(<0-3)	(27-37)	(8-14)
	n	361	101	67	20	12	2	3	116	40
SFBR	Percent		16	18	5	5	1	2	41	13
	95% CL		(12-21)	(13-24)	(2-8)	(2-8)	(<0-3)	(1-5)	(35-47)	(8-17)
	n	243	40	43	11	11	2	5	100	31

^a "Other" includes IDFG personnel, Internet, school, fishing club, job, licensed vendor, radio, and nature center.

Demographics and Education Response

Following the education effort, MFBR anglers using different gear types all improved in their ability to recite the bull trout regulation, but differences among gear types remained. During 1999, 96%, 90%, and 87% of fly, lure, and bait MFBR anglers, respectively, could recite the no-harvest regulation. During the pre-education survey in 1998, 80%, 62%, and 57% of anglers in the same respective groups could recite the regulation (Table 5). These differences between the two survey years result in a 20%, 45%, and 53% increase in regulation awareness within the respective gear type groups following the intense education campaign. A similar relationship among years was observed regarding improvements in bull trout identification ability; however, the differences were greater. The proportion of fly, lure, and bait anglers correctly identifying the bull trout increased 49%, 90% and 156%, respectively. Despite the

large improvement for bait anglers, 54% of those interviewed still misidentified the bull trout replica following the extensive education effort (Table 5).

MFBR anglers in the 19- to 24-year-old age group benefited the most from the education effort. The proportion of anglers in this age group that could correctly recite the bull trout regulation improved from 37% in 1998 to 97% in 1999, the highest result for any age group. In addition, the 19-to 24-year-old age group's ability to identify bull trout increased more than fourfold during 1999 to 56%, well within the range of the other older age categories (Table 5). The youngest group of anglers (<18) also appeared to benefit strongly in terms of regulation awareness for bull trout, which increased from 33% to 82%. However, 1999 anglers in this youngest age category lagged well behind all other age groups in their ability to identify bull trout correctly at only 41%. In addition, their ability to recite section-specific regulations declined 15% from 1998 to 1999, the largest post-education decline of any demographic group (Table 5).

Following the education effort, other differences were observed among the remaining MFBR demographic categories as well. Female angler ability to identify bull trout increased nearly threefold from 10% to 39%, the largest improvement in any demographic group. This increase was substantially greater than the 74% improvement observed for male anglers. A similar relationship was observed for ability to recite the bull trout regulation, although the disparity between the two groups was not as great (Table 5). Anglers with over 16 years of education were more likely than any demographic group to correctly recite the bull trout regulation (98%) in 1999. However, ability to recite section-specific regulations declined 25% for this same group of anglers post-education, about four to six times the decline in less educated groups. Resident anglers appeared to benefit more from education (42% increase) than non-resident anglers (29%) in terms of ability to recite the bull trout regulation. However, the opposite appeared true concerning bull trout identification (Table 5).

Illegal Bull Trout Harvest Rates

Illegal bull trout harvest rates declined markedly post-education. During 1998, 344 MFBR anglers interviewed while actually fishing had expended a total of 861.5 hours (mean = 2.5 h). Five individual anglers had a lone bull trout in possession (2%, 95% CL = 1% to 4%) for an illegal harvest rate of 0.006 fish/h. During 1999, 574 MFBR anglers interviewed while actually fishing had expended a total of 1108 hours (mean = 1.9 h) and had no bull trout in possession for an illegal harvest rate of 0.0 fish/h. On the SFBR in 1998, 52 anglers interviewed while fishing had expended a total of 153 hours (mean = 2.9 h), and a single angler had a lone bull trout in possession (2%, 95% CL = 0% to 12%) for an illegal harvest rate of 0.007 fish/h. In 1999, 523 SFBR anglers interviewed fishing had expended a total of 868 hours (mean = 1.6 h) and had no bull trout in possession for an illegal harvest rate of 0.0 fish/h.

Vandalism

During the 1999 education effort, some vandalism occurred on both the sign and poster locations. Posters were removed at least once from 55% of the 47 locations in the MFBR and the number of replacement posters used per site ranged from zero to seven. On average, two posters per location per year were necessary to maintain a constant education presence. One MFBR sign was pulled down twice and reinstalled without damage to the sign. Signs at two other MFBR locations were heavily damaged twice by vandals with shotguns; thus, a total of four replacement road signs were installed during the high intensity education campaign. In addition, one of the SFBR signs was shot but not replaced during the angling season.

Table 5. Change in regulation awareness and angler ability to correctly identify bull trout replicas for demographic groups of Middle Fork Boise River anglers, May 23 to October 17, 1998 and May 29 to October 1, 1999.

Measurement	Sex		Age					Gear			Education			Residence		
	M	F	≤18	19-24	25-34	35-44	45-54	55+	Bait	Lure	Fly	<13	13-16	>16	ID	NR
1998 Proportion correct 1999 Proportion correct Percent Change	50	29	38	30	48	49	51	54	29	51	61	48	54	83	47	38
	54	28	32	52	46	55	57	56	36	50	67	46	51	63	51	40
	8%	-3%	-16%	73%	-4%	12%	12%	4%	24%	-2%	10%	-4%	-6%	-24%	9%	5%
1998 Proportion correct 1999 Proportion correct Percent Change	68	48	33	37	69	69	73	69	57	62	80	60	65	85	65	62
	92	84	82	97	95	95	93	84	87	90	96	87	93	98	92	80
	35%	75%	148%	162%	38%	38%	27%	22%	53%	45%	20%	45%	43%	15%	42%	29%
1998 Proportion correct 1999 Proportion correct Percent Change	34	10	24	13	31	33	34	34	18	30	47	28	30	49	31	24
	60	39	41	56	61	55	60	59	46	57	70	48	60	70	57	51
	76%	290%	71%	331%	97%	67%	76%	74%	156%	90%	49%	71%	100%	43%	84%	113%
1998 N 1999 N	455	94	550	75	170	130	102	65	244	83	172	193	182	41	508	42
	540	99	639	98	178	163	116	73	246	136	219	252	291	96	604	35

^a The percent increase or decrease in 1999, relative to 1998 estimate.

DISCUSSION

Our results show that an angler education program conducted at either of the intensities tested can have a positive effect on angler regulation awareness for a single target species. Relative to pre-education levels (1998), angler awareness of the no-harvest regulation for bull trout in 1999 increased 40% and 33% for the MFBR and SFBR, respectively, and confidence limits around point estimates for the two study years by water did not overlap (Figure 3). In the high intensity education evaluation, the estimated difference between the two study years was 26%, and confidence limits around this value were reasonably precise, ranging from 21% to 30%. Consequently, decision-makers considering whether to implement a similar education program elsewhere can be assured that the reported 26% difference in the present study is real. In the low intensity education evaluation on the SFBR, the estimated difference between the two study years was 19%. However, due to the small pre-education sample, confidence bounds around this estimate were much larger, ranging from 6% to 32% (Figure 3). Therefore, although our results suggest a statistical difference in regulation awareness for the SFBR based on non-overlapping confidence bounds, decision-makers considering the expense of a low intensity effort should be aware that the actual difference in awareness rates could be less than 10% based on the data collected.

Our angler education program focused on a single species produced mixed results in terms of angler ability to recite other non-targeted fishing regulations. Although overall angler ability to recite section-specific regulations improved slightly on the MFBR from 47% to 51%, this result was heavily influenced by anglers interviewed in Section 5 where the correct recitation rate increased from 33% to 60% post-education. On all other MFBR sections, ability to correctly recite section-specific regulations declined slightly (Table 3). With the exception of those sections where n was less than 10, similar declines were observed on SFBR sections, and the overall ability of SFBR anglers to recite section-specific regulations declined from 54% in 1998 to 40% in 1999 (Table 3). However, it is also possible that the signs and posters pertaining to bull trout made anglers in most sections more aware of their knowledge deficiency concerning other pertinent regulations. As a result, anglers may have been unwilling to venture an answer when asked to recite section-specific regulations.

Results of this study demonstrate that an intense education effort can have a large impact on angler ability to identify bull trout, but that a low intensity effort will not. On the MFBR, angler ability to identify bull trout nearly doubled in 1999, and the 26% difference in identification rate between years was bounded by fairly precise confidence limits of 21% to 32% (Figure 3). Thus, decision-makers can again be reasonably certain that the above difference is real when considering expanding this program to other waters. However, the low intensity education effort did not result in statistically better bull trout identification rates based on non-overlapping confidence bounds for the pre-post estimates (Figure 3). In addition, the confidence bars around the small difference (6%) between the two study years included values less than zero. Thus, it is possible that no benefits might have been derived based on the data collected (Figure 3).

Education intensity also appeared to affect the pre-post identification results for species other than bull trout in the two study streams. On the high intensity MFBR, the proportion of correct identification increased on three of four non-target replicas presented to anglers. For rainbow trout and cutthroat trout, the two non-target species most commonly caught in the study area, angler identification rates in 1999 were statistically greater based on non-overlapping confidence bounds (Figure 4). In the case of the high intensity education effort on the MFBR, it

seems that anglers being exposed numerous times to information about how to identify bull trout encouraged some anglers to review their identification knowledge for other species, perhaps by reviewing the regulation pamphlet. The relationship was different on the low intensity SFBR where the correct identification rate for rainbow trout remained the same, and small declines were observed for the other three non-target species (Figure 4). It is possible that anglers were not exposed to enough signs or posters on the SFBR to foster adequate interest in their learning identifying characteristics of other species. With the exception of commonly observed rainbow trout, angler identification rates for all other species on the SFBR in 1999 lagged 7% to 12% below those observed on the high intensity MFBR in the same year (Figure 4).

Several limitations to the study must be considered when evaluating the results. A low number of SFBR anglers were contacted in several study sections during the 1998 sampling effort. This factor, and the small sample size for SFBR angler interviews in 1998 ($n = 67$), limited our ability to compare pre- and post-education data sets. This may partly explain the decline in post-education regulation awareness and identification results for non-targeted species as discussed above. In addition, the small 1998 SFBR sample is largely the cause of the wide confidence bars reported above for SFBR differences in both bull trout regulation awareness and identification ability. Clearly, results from the SFBR evaluation of a low intensity education effort are more tenuous than those of the MFBR effort, which was based on sample sizes well above 500 in both study years. Despite the small sample size for 1998 SFBR results, bull trout regulation awareness and identification ability were both quite similar to pre-education MFBR results. This observation and the fact that the same southwest Idaho angler clientele comprised the vast majority of anglers on both waters suggest the SFBR 1998 data should be an adequate control for comparison to 1999 data.

Finally, there is the possibility that interviews we conducted during the 1998 pre-education surveys might have substantially improved overall 1999 angler regulation awareness or identification ability. While the 43 anglers interviewed in both 1998 and 1999 had little effect on overall 1999 results as noted previously, it is possible that the anglers interviewed communicated enough of their experience with other anglers, either in their group or campground, that the 1999 test of the three education options could be positively biased. However, anglers interviewed twice during the study expended a very small proportion (3.4%) of the total estimated MFBR angler effort during the 1998 angling season (J. A. Lamansky, IDFG unpublished data). It therefore appears unlikely that communication from these encounters could have measurably improved either bull trout regulation awareness or identification ability. Influence of 1998 interviews on 1999 results for the SFBR is even more unlikely due to the very small number of interviews obtained.

Our evaluation indicates that, of the three education tools tested, signs were by far the most effective method for improving angler knowledge of bull trout regulations and bull trout identification. Signs were used as a primary or secondary information source by 52% and 73% of SFBR and MFBR anglers correctly reciting the no-harvest regulations. They were 11-13 times more likely than the posters to be cited by anglers as their primary information source for correctly reciting the bull trout regulation regardless of the signing intensity (Table 4). Signs were also about three to five times more likely than the posters to be the primary source for anglers correctly identifying bull trout. The response to the posters was disappointingly low, especially on the MFBR where the 47 poster sites required frequent replacement. After the first week of the 1999 survey, we questioned anglers providing information sources in detail to make sure they clearly understood the difference between the signs and posters during the interviews to avoid any confusion; the large disparity in importance between the signs and posters

remained. Based on these results, we recommend the use of larger road signs over streamside and campground poster programs if such measures are being contemplated.

Results from the present study suggest that the sticker campaign involving their distribution to license vendors provided little benefit. However, due to production delays, stickers were not distributed to southwest Idaho vendors until the day before the angling season; hence, many anglers had purchased licenses and fishing equipment prior to their being made available. Consequently, our evaluation of sticker distribution as a measure to improve bull trout awareness is incomplete. However, printing and production costs for 100,000 stickers were minimal at \$3500, and statewide distribution was accomplished by an established mailing network for IDFG license vendors. Given this consideration and their subsequent prominence at sporting goods stores statewide, their utility should not be ruled out based on the poor showing in our evaluation.

A signing program as intense as that tested on the MFBR will not be acceptable to all land managers. While USFS land managers and personnel overseeing the MFBR actually requested road signs installed in more locations than erected, supervisory personnel on the nearby SFBR were decidedly negative about the signing and poster effort. Even if a more intense education effort had been desired on the SFBR, it would have most likely been rejected in that instance. Differences of opinion concerning the need for, utility, and aesthetic aspects of signing efforts may limit applicability of road signs in some areas.

In addition, high intensity signing efforts such as that tested on the MFBR will likely not be affordable everywhere given the widespread distribution of bull trout in Idaho. The road signs cost approximately \$140 each, including supporting posts and hardware. Thus, the MFBR signing effort, including vandalism, cost approximately \$3900 excluding labor, which was jointly shared by USFS and IDFG personnel. Our results suggest that as many signs as possible should be installed considering cost, bull trout population status, and visual aesthetics. Given the factors discussed above, an ideal density of road signs would likely be somewhere in the middle of the two intensities we tested. Such a sign program could be viewed as a temporary tradeoff between resource protection and aesthetic loss; we attempted to mitigate the latter by sign design and appearance.

As noted previously, few documented evaluations of education efforts exist in the fisheries literature. Martin (1995) was unable to modify angler behavior using a multifaceted campaign encouraging anglers to harvest largemouth bass outside a protected slot. Baayens and Brewin (1998) reported that 90% of mail survey respondents in Alberta were aware of the no-harvest regulation for bull trout following a province-wide education contest and other related efforts implemented over several years as described by Brewin (1997). This post-education result was virtually the same as that reported for our high intensity education effort on the MFBR (91%). However, Baayens and Brewin (1998) did not collect pre-education estimates of bull trout regulation awareness for direct comparison. In addition, this study did not report on angler ability to identify bull trout after an education effort. Dolsen and Landry (1996) reported statistically positive results from an education campaign in western Montana, but actual increases in many of the variables evaluated were small from a management perspective.

We are aware of no published field evaluations of sign or poster effectiveness in a fishery setting, but limited evaluation of education tools has been done in other resource fields. Johnson and Swearingen (1992) evaluated the effects of a number of different signs on off-trail hiking in Mount Rainier National Park. All posted signs statistically reduced the incidence of unwanted behavior from 6.9% in an unsigned control situation to 1.7% to 4.9% with signs.

Schwartzkopf (1984) found that signs were two to four times more effective in deterring visitors from feeding wildlife in parks than no signs at all. Ross and Moeller (1974) evaluated communication of rules in a recreational camping setting and found that less than half of sampled campers recalled reading rules, although 65% reported seeing signs on which they were posted. Respondents exposed to either rule brochures or posted signs had statistically higher regulation knowledge scores than those not exposed. Overall, however, only 49.5% of campers answered questions pertaining to rules correctly, despite their being posted. Marler (1971) studied anti-litter messages communicated via brochures distributed to campers. Only 65% to 70% of campers were handed a leaflet, and 60% of them subsequently reported reading them; therefore, only about one third got a message on littering.

Additional research suggests sign location is very important in reducing non-compliant or depreciative behavior. In a study of handicap parking areas, Jason and Jung (1984) reported an average compliance rate of 47% when a symbol for the handicapped was painted at the front end of a parking spot. Compliance increased to an average of 96.5% during subsequent periods of time when a similar sign was posted vertically at the front end of the same parking location. In a successful effort to increase compliance with voluntary registration rules on hiking trails, Peterson (1985) noted that sign location was the most important factor examined; placing them along the trail was more effective than using traditional trailhead locations. Ross and Moeller (1974) suggested signs or posters be placed inside restroom and shower facilities in campgrounds, because most people visit these facilities. Presenting information in restrooms might be especially beneficial, because it would give visitors time to read the message (Trapp et al. 1992) and would also reduce any visual aesthetic concerns which should be a factor in sign or poster placement (Ross and Moeller (1974).

Although lacking any direct evidence, we suspect that sign location might have played a role in the variable angler response to our education efforts. Specifically, Section 5 anglers far surpassed others in their response to the education tools tested. The increase in awareness of the section-specific regulation for this section nearly doubled in 1999, dwarfing any increase in such regulation knowledge in other study sections (Table 3). In addition, Section 5 angler ability to recite the bull trout regulation and identify bull trout improved to 99% and 70%, respectively, again far surpassing anglers interviewed in any other section where adequate sample sizes were available for comparison. Sign locations available in Section 5 appeared to be optimum for obtaining and holding the attention of drivers. Many of these locations were associated with turns that required anglers to stop for a short time or where pull-offs near the sign were especially inviting. While we attempted to select such sites for all sign locations on the MFBR, many of those in Section 5 appeared to be especially attractive. Other than this potential but difficult-to-quantify difference in sign locations, we have no ready explanation for the remarkably improved performance of Section 5 anglers following education efforts relative to anglers fishing other MFBR sections.

In addition to sign location, it has been suggested that wording or message tone is important in on-site communication of rules and regulations. In their study of littering in a cafeteria setting, a positively worded behavior prompt resulted in less littering than a negative prompt (Durdan et al. 1985). Ross and Moeller (1974) suggested that signs could be more effective if no hostile or dogmatic tone were voiced. For example, "NO DOGS ALLOWED" could be changed to "Sorry-Pets Not Permitted," or the sign "DO NOT ENTER" could be changed to "Closed."

The theoretical basis for such an approach is provided by the theory of reactance (Brehm 1966). Reactance theory suggests that when a regulation is perceived as a threat to an

individual's freedom of choice, the threat is resisted and a non-compliant act itself is seen as more desirable than compliance (Vande Kamp et al 1994). The size of the threat influences the degree of reactance that may be experienced. If the threat is low, reactance may not be aroused and the individual may be more willing to accept a persuasive message (Reiter and Samuel 1980). Based on reactance theory, sign messages that include threats of personal fines or note involvement of a specific enforcement agency might be expected to arouse reactance from some members of the public.

Empirical evidence for reactance in signing programs is mixed. There is evidence that an intervention program can produce just such a boomerang effect (e.g., Pennebaker and Sanders 1976). In a study of litter behavior by Reiter and Samuel (1980), a sign with punitive tone did not arouse reactance during the first exposure, but subject behavior after subsequent exposure led investigators to conclude that reactance was a possibility. However, in a study of littering in campgrounds, Marler (1971) concluded that a negative punishment-oriented message produced the best results. In addition, two similarly designed studies in two national parks concluded that the most effective sign reducing depreciative behavior was a sanction sign noting a penalty (Martin 1987; Johnson and Swearingen 1992).

The signs and posters developed in our study were designed with findings of the latter three studies in mind, along with the possibility that reactance to the bull trout education efforts could occur depending on other wording. Both the posters and the signs included text that harvesting a bull trout could result in a \$200 fine. The last message on all three educational tools we tested requested anglers "be safe" and let fish go if they were unable to identify them. This text wording was selected to dull the sharp message of the fine and hopefully help anglers realize that regulatory agencies were, in fact, interested in helping them stay out of trouble. Johnson and Swearingen (1992) demonstrated that a humorous sign reduced levels of off-trail hiking in vulnerable meadows by about the same rate as other approaches, excepting a sign with a clear sanction. By imploring anglers to "Know your Bull!" and by invoking the concept of a "Wanted" poster, we hoped the two posters would be fun and provocative enough to make anglers want to read the message below (Trapp et al. 1992).

In addition to minimizing reactance, care must be taken not to negate the communication value of posted signs by poor wording (Ross and Moeller (1974). Trapp et al. (1992) provides an excellent reference for resource professionals designing signs. Recommendations include sign face components, size of lettering, spacing, justification, graphics, etc., and suggested that wording be tested for complexity using a Flesch test. Although the signs developed for the present study attempted to incorporate a number of these concepts and were successful in improving angler awareness of bull trout regulations and their appearance, several references cited above were located subsequent to our sign construction. Therefore, we challenge other agency personnel contemplating signing programs for similar educational purposes to improve upon our initial design.

Although angler awareness on the high intensity MFBR was much improved following education efforts at 91%, identification ability on both streams was still far from an acceptable level. This should not be construed as evidence that anglers are illegally creeling large numbers of bull trout, however. Based on our angler interviews, illegal bull trout harvest rate declined from 0.006-0.007 fish/h in 1999 to zero in both streams post-education. Further, Lamansky et al (2001) reported that expanded creel survey estimates of bull trout harvest for the season in the MFBR declined from 149 fish to zero fish in 1999. Although a large number of anglers could not recite the no-harvest regulation or identify bull trout regulation correctly, it is possible that many anglers read and acted on the "be safe...let it go" message. Estimated total angler catch

increased 67% on three MFBR study sections in 1999 due to considerably better fishing conditions, but estimated total harvest declined by 8% (Lamansky et al 2001). If such a harvest decline was actually related to the "Don't know, be safe, and let it go" campaign, it would spell success in the short term regarding the education campaign. However, from a management perspective, anglers not harvesting fish because they are afraid to would be undesirable in the long term.

While maintenance of the existing signs on the study waters is desirable, along with subsequent sign installation on other waters statewide, additional education options will likely be necessary to produce bull trout identification rates in excess of 90%. Based on results from angler interviews, many anglers used the IDFG regulation pamphlets to correctly answer our bull trout queries (Table 4). In addition, 72% of Alberta anglers reported receiving bull trout messages from the Alberta Guide to Sportfishing, an annual government publication describing provincial sportfishing regulations (Baayens and Brewin 1998). Based on these observations, information on the bull trout no-harvest regulation, a color picture, and key identifying characters were placed on the IDFG regulation pamphlet cover prior to the 2000 angling season. Other options being considered include a fish identification sweepstakes (Baayens and Brewin 1998) and direct mailing of stickers to demographic groups with the worst results (Schill and Lamansky 1999). Both posters developed for this study have subsequently been sent to many vendors statewide and currently appear on their doors, near license vending machines, etc. Distribution of posters to vendors should be continued and consideration given to changing the headers and design to attract additional angler attention.

Walder (1994) summarized results from an Alberta workshop where 41 participants, including biologists, industry representatives, interest groups, and other jurisdictions ranked priorities for budget allocation in regard to bull trout restoration. Communication and education received 27% of the allocation for initial efforts, declining to 23% in the long term. While such a funding commitment is not likely in Idaho or elsewhere, additional funds and manpower will need to be expended if angler ability to identify all species in their catch is desired.

RECOMMENDATIONS

1. Evaluate angler regulation awareness and trout identification ability for other species in additional geographic regions of the state.
2. Continue the signing programs in the MFBR and SFBR and expand the signing program to other bull trout waters. Based on the study results and other practical considerations discussed above, an intermediate program between the two education intensities tested in the study would be desirable. Based on our results, a program that requires anglers to drive by a minimum of two road signs would be desirable.
3. Conduct similar field interviews periodically in the future on the SFBR and MFBR to determine if existing and other possible education efforts result in angler regulation awareness and identification abilities for bull trout approaching 100%.
4. Develop additional statewide approaches and funding mechanisms for increasing Idaho angler regulation awareness and fish identification ability for bull trout and other species.

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APPENDICES

Appendix 1. Photo of a typical 1.6 X 1.6 m sign installed along the Middle Fork Boise River as part of the high intensity education effort.



- Appendix 2. The two versions of posters installed at 47 access sites along the Middle Fork Boise River and 10 sites on the South Fork Boise River in 1999.

WANTED

Anglers who can identify Bull Trout.

In a recent survey, only thirty percent of Idaho anglers could identify the Bull Trout. Can you? Bull trout have light colored spots on their olive green to brown back and sides. The spots are usually round pale shades of yellow or salmon color. However, the key to identifying Bull Trout is the absence of spots on any of the fins.



The Bull Trout (alias Dolly Varden)

Don't let a case of mistaken identity ruin your day!

Bull Trout live in these waters and may not be kept. If you catch a Bull Trout it must be released immediately back into the water. Keeping one can cost you at least a \$200 fine. Bull Trout share waters with other trout that may be kept, so knowing how to identify the fish you catch is very important. Not positive of what you catch?

If you don't know, be safe and let it go!

because it may be a Bull Trout.



This poster provided for your information by the U.S. Forest Service, Division of Land Management, U.S. Fish and Wildlife Service and the Idaho Department of Fish and Game. Angler fishing areas have established Bull Trout Special Fisheries. Anglers are urged to follow all regulations.

Know Your Bull!

Be sure you can identify the Bull Trout.



Bull Trout (Sometimes called Dolly Varden) have light colored spots on their olive green to brown back and sides. The spots are usually round pale shades of yellow or salmon color. However, the key to identifying Bull Trout is the absence of spots on any of the fins.

If You Are Fishing Today...

Bull Trout need your help. Bull Trout live in these waters and may not be kept. If you catch a Bull Trout it must be released immediately back into the water. Keeping one can cost you at least a \$200 fine. Bull Trout share waters with other trout that may be kept, so knowing how to identify the fish you catch is very important. Not positive of what you catch? Remember...

"If you don't know, be safe and let it go!"

because it may be a Bull Trout.



This poster provided for your information by the U.S. Forest Service, Division of Land Management, U.S. Fish and Wildlife Service and the Idaho Department of Fish and Game. Angler fishing areas have established Bull Trout Special Fisheries. Anglers are urged to follow all regulations.

Appendix 3. The 5 X 10 cm vinyl sticker distributed to southwest Idaho license vendors and during angler interviews on the Middle Fork Boise River in 1999.



- Appendix 4. Photo of a 1.6 X 1.6 m sign installed along the South Fork Boise River by regional management personnel as part of the low intensity education effort, May 1999.



Appendix 5. Angler interviews survey form used for fish identification data collection, 1999.

BODY OF WATER:

DATE:

DAY TYPE:

IDAHO DEPT. OF FISH AND GAME
CREEL SURVEY SYSTEM
INTERVIEW FIELD FORM

PAGE ____ OF ____

CLERK:

2000

[illegible]

QUESTIONS

- 1 -- HAVE YOU BEEN INTERVIEWED FOR FISH IDENTIFICATION BEFORE? (IF YES, IN 98 OR 99?)
- 2 -- HOW MANY YEARS OF ANGLING EXPERIENCE DO YOU HAVE?
- 3 -- CAN YOU RECITE THE REGULATIONS FOR THE AREA WE ARE IN?
- 4 -- HOW WOULD YOU RATE YOUR ABILITY TO IDENTIFY TROUT ON A SCALE OF 1 TO 5, WITH 5 BEING MOST CONFIDENT?

****TAKE LENGTHS ON ALL FISH IN CREEL

****DIFFERENTIATE HATCHERY AND WILD RAINBOW (HRB, WRB) IN CREEL..

****IF USING MORE THAN ONE GEAR TYPE, CIRCLE THE MAIN ONE USED.

**** IF PARTY FISHING (GROUP ALL TOGETHER) BRACKET THE INTERVIEWS OF THE PEOPLE IN THE GROUP ON THE FORM.

	S -- SIGN	TV -- TELEVISION	WM -- WORD OF MOUTH	
	P -- POSTER	FQ -- F AND G STAFF	LV -- LICENSE VENDOR	
	ST -- STICKER	RA -- RADIO	MG -- MAGAZINE	
	RG -- REGS	NP -- NEWSPAPER	EX -- PERSONAL EXPERIENCE	
PERFORM THE IDENTIFICATION EXERCISE				
5 -- DO YOU KNOW THE REGULATION FOR BULL TROUT/DOLLY VARDEN?				
6 -- HOW DID YOU GET YOUR INFORMATION CONCERNING THE BULL TROUT REGULATION?				
7 -- HOW DID YOU GET YOUR INFORMATION CONCERNING BULL TROUT IDENTIFICATION?				
8 -- HAVE YOU FISHED IN THE MF OR SF BOISE IN 2000 (OPPOSITE OF CURRENCY RIVER)?				
9 -- HOW ABOUT LAST YEAR (1999)?				
RAINBOW --	RET	SQUAWFISH --	SQ	
CUTTTHROAT --	CT	KOKANEES --	KOK	
BROOK TROUT --	BK	COHO --	CH	
BULL TROUT --	BT	SALMON --	SAL	
BROWN TROUT --	BR	DIDN'T KNOW --	U	
WHITEFISH --	WT			
SUCKER --	SU			

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